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U. S. DEPARTMENT OF AGRICULTURE.

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FARMERS' BULLETIN 341.

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# THE BASKET WILLOW.

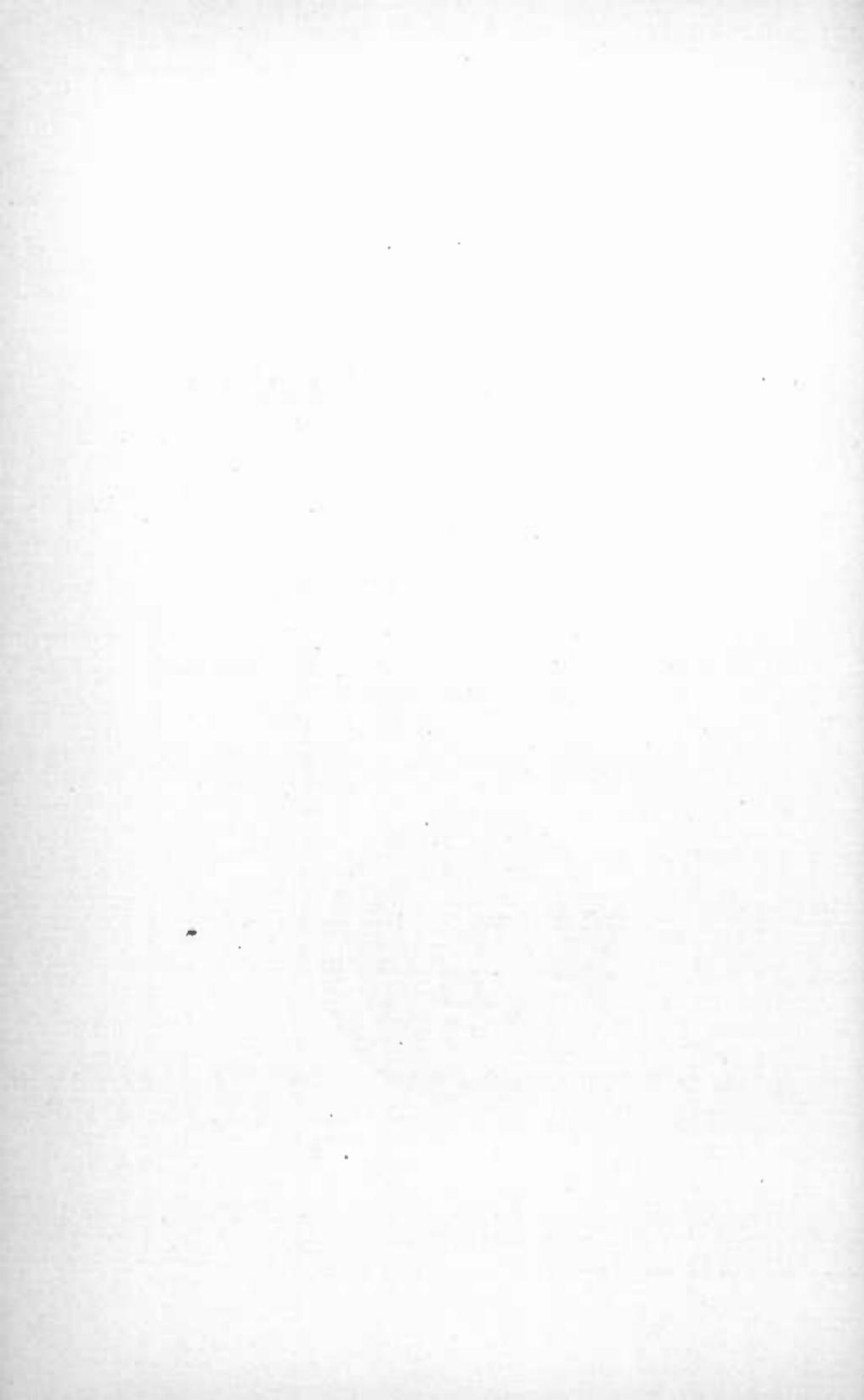
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WITH A SUMMARY BY C. D. MELL, ASSISTANT DENDROLOGIST, FOREST SERVICE.



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## LETTER OF TRANSMITTAL.

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U. S. DEPARTMENT OF AGRICULTURE,  
FOREST SERVICE,

*Washington, D. C., November 17, 1908.*

Mr: I have the honor to transmit herewith a manuscript entitled "The Basket Willow," by William F. Hubbard, Forest Assistant, Forest Service, and to recommend its publication as a Farmers' Bulletin. This paper is a condensation and revision of Bulletin 46 of the Forest Service.

Very respectfully,

GIFFORD PINCHOT,

*Forester.*

Hon. JAMES WILSON,  
*Secretary of Agriculture.*



## CONTENTS.

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	Page.
Introduction.....	7
Distribution.....	8
Characteristics.....	9
The present culture of willows in America.....	10
Position of the holt, or willow plantation.....	11
Preliminary cultivation.....	12
Planting.....	13
Weeding and cultivation.....	13
Cutting.....	14
Drafting and peeling.....	15
Suggested improvements in culture.....	18
Choice of land and preliminary cultivation.....	18
Planting.....	20
Weeding and cultivation.....	22
Fertilizing.....	22
Insects.....	22
Cutting.....	23
Peeling, sorting, packing, etc.....	27
Expenditure and returns in American willow culture.....	27
Willows grown on upland.....	27
Willows grown on land subject to inundation.....	29
Systems of peeling compared.....	31
Field experiments of the Forest Service.....	32
Willows for growing in America.....	33
Manufacture of willow ware in the United States.....	35
General remarks.....	35
Wicker furniture.....	35
High-grade willow basket ware.....	37
Low-grade willow basket ware.....	39
Suggestions for basket makers.....	42
Summary statement.....	42

## ILLUSTRATIONS.

---

	Page.
FIG. 1. Purple or Welsh willow ( <i>Salix purpurea</i> ), part of which has been killed by standing water. New York, July, 1902.....	10
2. Almond or American green willow ( <i>Salix amygdalina</i> ), on well-drained bottomland; rods 7 to 8 feet high. Maryland, September, 1902....	11
3. Purple or Welsh willow ( <i>Salix purpurea</i> ) planted 3 feet by 1 foot. Maryland, September, 1902.....	12
4. Typical willow bottomland. Maryland.....	12
5. Willows on drained land; cut and subsequently inundated. Maryland, March, 1903.....	13
6. Effect of undrained land. Maryland, March, 1903.....	14
7. Drafting (sorting) willows.....	15
8. Willows in the pit, sprouted and ready for peeling.....	16
9. Knife for cutting rods.....	16
10. Seven types of brake.....	17
11. Peeling willows in the sap.....	18
12. Drying the peeled rods on the racks.....	19
13. Machine for bundling willows for market.....	20
14. Ideal location for basket willow growing.....	21
15. Comparison of close planting and good cutting with wide planting and careless cutting.....	23
16. Welsh or purple willow.....	24
17. Lemley or Caspian willow.....	25
18. American green or almond willow.....	26
19. Example of good and bad methods of cutting.....	32
20. First-year rods of common white willow from newly planted sets. Germany, November, 1902.....	34
21-22. High-grade willow furniture.....	36-37
23. High-grade willow ware.....	38

# THE BASKET WILLOW.

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## INTRODUCTION.

The cultivation of the basket willow began very early. Among the ancient Romans the shoots were used for the manufacture of beehives and baskets, for garden and vineyard fences, and for binding grapevines, and the wood, covered with hide and bossed with brass, was made into shields, for which purpose its elasticity and lightness peculiarly fitted it. During the middle ages willows were commonly used for basket ware, and in France, and later in Germany, the basket makers' guilds were of considerable importance. During the seventeenth and eighteenth centuries, however, the industry languished.

At the present time France, Italy, the islands of Sicily and Madeira, Belgium, Holland, Germany, Austria, and Russia are all large growers of willow, and have a good export trade of willow rods and basket ware. In all these thickly peopled countries, which abound in cheap labor, willow growing and basket making have followed the development of other manufactures to a very marked degree. In the United States the conditions are altogether different from those on the continent of Europe. Here raw material is cheap in comparison with the cost of labor, and nearly every branch of manufacture tends to concentrate in large establishments with a great number of labor-saving devices. Such an industrial condition has relegated basket making to a very small position in the general world of manufacture. Yet a comparatively small part of our population is made up of highly paid skilled laborers; the great bulk of the people is scattered in the agricultural districts, doing more or less independent hand labor. It has been observed in all countries that willow growing gives an uncommonly high margin of profit. A large demand for willow is now supplied by import, and as American-grown rods are of good quality when proper care is taken in their culture, there is no reason why the further development of the industry should not be possible, if more American farmers can be convinced of its practicability.

Although the last census shows a great falling off since 1899, as does the import of both rods and basket ware, the manufacture of willow furniture, which is lost in the total figures, shows a most promising condition when separately considered. Of late years willow furniture has sprung into fashion, and to-day no minor industry is more prosperous than that devoted to its supply. The wages are

good, and the manufacturers demand a steady supply of superior willow. This is now almost entirely received from France at a price which will give the entire trade to the American if he can equal the quality. In basket ware proper the decline seems to have reached bed rock. Experience has proved that no stock is equal to willow when durable baskets are demanded. The high-class basket has made a place for itself in the market even under present circumstances, and the entire decline in the trade has been in the low-priced basket, which competes with the foreign willow product or the American-made wooden basket. To put a low-priced basket on the market with raw willow at its present price the wages must be cut lower than the normal standard in America. For this reason the trade is almost entirely in the hands of immigrant basket makers, who know no other trade and who are seldom or never reenforced by native workmen.

The remedy lies in a reduction in the cost of the raw material. The cheaper the willow (when good in quality) the better the wages which can be paid to produce a low-priced basket, and a low-priced basket of good quality will find an almost unlimited market. On this point the entire trade agrees.

Thus the problem has but one solution. A good grade of willow must be produced at a low cost. To do this, better and more scientific methods must be introduced. At present the willow is grown in the rudest manner possible, and several inferior varieties are planted. The following pages will show how the yield per acre may be increased and the quality of stock bettered. The price will then fall, but with a corresponding gain to the grower in the lessened cost of production. On this depends the future success of basket making in America. An incentive to improvement should be the fact that even under present conditions the American willow tends to displace the foreign in the home market.

## DISTRIBUTION AND CHARACTERISTICS OF THE WILLOW.

### DISTRIBUTION.

Willows are adapted to a wide range of soils and climatic conditions, and are therefore among the most widely distributed of trees and shrubs. The genus *Salix*, to which these plants belong, contains a large number of species, ranging from large trees to a small, low plant. From 160 to 170 species are known, inhabiting all regions from the bog woods and river banks of temperate climates and warm countries to the arid Alpine slopes of mountains and to the boreal regions of both hemispheres.<sup>a</sup> They occur in America from the

<sup>a</sup> There are at least 92 varieties, hybrids, and crosses of the basket willow enumerated in the dealers' catalogues.

Arctic Circle to the West Indies and the mountains of Chile. In the Old World they range from northern Europe and Asia to Madagascar and South Africa, and to the islands of Java and Sumatra.

True to the characteristics of the genus, the basket willow also has a wide distribution over varying climatic conditions. In Europe *Salix viminalis*, *amygdalina*, *purpurea*, etc., are successfully grown from Russia, Sweden, and Norway far down into Italy and the Mediterranean islands. In America it is difficult to decide positively just how far the commercial range of the European basket willow coincides with the boundaries within which it is at present grown. How far willow growing can be extended in this country may be found only by actual experience; yet there is every reason to believe that suitable places for willow growing exist throughout the entire United States. There is continual record of small imports of willow from the West Indian islands; and it is quite certain that northern willows suffer quite as much from insect pests as those on the southern boundary of the present willow-growing section. For these reasons it would seem that the South has a good future for this industry if favorable positions are sought for the holtz. On the Pacific coast also the high transportation rates which must be paid for the foreign or eastern article should give willow growing a chance to become an economic industry. A start has already been made in California.

#### CHARACTERISTICS.

In a genus with such a wide range it is but natural that the wood should answer many needs. Both in Europe and to a lesser degree in America the wood is used for many purposes. In this report, however, only the basket willow will be considered.

Although the willow is one of the most widespread and accommodating of plants, and shows such an endless variety of strains, the varieties used in basket making will by no means flourish commercially on all kinds of soil. It is a mistaken idea, however, that it will thrive only on marshy land, though it is true that a fresh soil is needed. That the willow is nevertheless characteristically found in wet places when growing wild is due less to its demands than to its adaptability. It has a poor height growth, and being also intolerant of shade, finds its only chance for life in its capacity for soil adaptation. It is not at all sensitive to moisture, and hence is forced to grow on river banks and lowlands. This is further necessitated by the fact that its seeds can not sprout save on soft, open soil which is free of weeds, and lose their powers of germination in a few days. Such seeds, when left to nature's conditions, find their most favorable bed on the soft alluvial deposits of river banks.

When grown as an article of commerce, the willow is removed from all natural competition, and therefore should be put in a position suited for its development. Both European and American experience have shown that rods grown on moist, rich, well-drained bottomland are more flexible, tougher, and less branchy than those grown on undrained marsh land. This does not mean that valuable fields should be given over to the willow. The most exacting of trees is far less sensitive to soil conditions than any farm crop, and willows thrive on soil which produces even a very poor quality of grass. But the fact remains that the swamp is not the favorite home of the basket willow, and, if a high grade of osier rod is wanted, land permanently saturated with water should be avoided. Ground which is often overflowed grows willow of a high quality, but it must be well drained.



FIG. 1.—Purple or Welsh willow (*Salix purpurea*), part of which has been killed by standing water.  
New York, July, 1902.

Long-continued inundation is fatal to all species (fig. 1). Nor should its excessive intolerance of shade be forgotten. Weeds and undergrowth of any kind prevent its luxuriant development.

#### THE PRESENT CULTURE OF WILLOWS IN AMERICA.

Although introduced by German immigrants in the period between 1840 and 1850, willow growing in America occurs only in restricted localities throughout a relatively small portion of the country. Because the growers are thus isolated into small groups with little or no connection, and because these growers are very seldom in touch with

the basket makers, there has been little chance for general improvement. It is true that in western New York basket maker and grower are in close communication, but there the trade demands only the cheapest grade of the steamed willow—a condition which, far from being an advantage to the grower, has been his greatest handicap.

Because of these conditions, and, further, because the system of culture, like American agriculture in general, has lacked intensiveness, little or no advance has been made on the method introduced sixty years or more ago.

#### POSITION OF THE HOLT, OR WILLOW PLANTATION.

Although the idea is common that willows grow only on swampy ground, it takes but little experience to explode this fallacy (fig. 1).



FIG. 2.—Almond or American green willow (*Salix amygdalina*) on well-drained bottomland; rods 7 to 8 feet high. Maryland, September, 1902.

Hence all serious attempts at willow culture are made on well-drained soil, even though it be of poor quality. In many places willows are grown on ordinary corn land, but generally they are planted in low-lying fields subject to occasional inundation (figs. 2, 3, 4, and 5), or in the swales and low places of grain fields, subject to the overflow or drainage of sudden rain storms. When planted on high ground the land chosen is deep and heavy, but when the holt (or willow bed) is subject to inundation the land may be of poorer quality.

## PRELIMINARY CULTIVATION.

In most parts of the country the ground is prepared for willows exactly as it would be for corn or wheat. The work is generally done



FIG. 3.—Purple or Welsh willow (*Salix purpurea*) planted 3 feet by 1 foot. Maryland, September, 1902.

in the preceding autumn, occasionally in the spring. Often where the willows are to be planted on waste bottomland subject to inundation

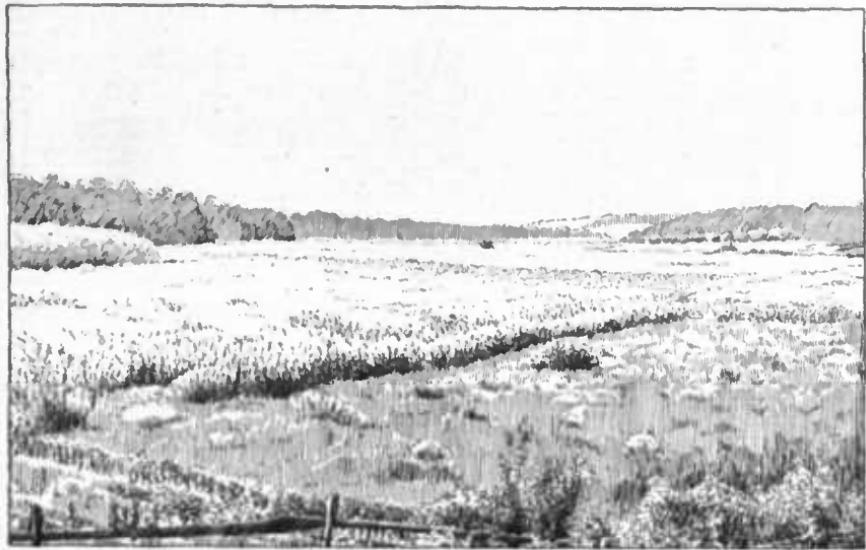


FIG. 4.—Typical willow bottomland. Maryland.

the wild growth is simply cut down and burned on the field and the willows are planted either with preliminary cultivation or in the raw soil.

## PLANTING.

Almost without exception throughout the country willows are planted from 9 inches to a foot apart, in rows  $2\frac{1}{2}$  feet to a yard distant from one another, or from about 14,000 to 23,000 per acre. Here and there occasional growers plant in closer order—even 18 by 8 inches<sup>a</sup>—but they are the decided exception. This method of wide planting is followed for several reasons. It is undoubtedly cheaper to plant fewer cuttings, and the cost of cultivation is much reduced, as a plow may be run through the wide rows. It is also a generally held opinion that the more shoots from a stool (or stump) the greater the yield. Finally, the practice is continued because those who introduced the industry planted in this manner.



FIG. 5.—Willows on drained land; cut and subsequently inundated. Maryland, March, 1903.

The sets (or cuttings) are cut from one-year shoots into sections about 10 inches to a foot in length and are generally planted with about an inch and a half out of the ground.

## WEEDING AND CULTIVATION.

The care of a holt depends so much on the character of the ground that two systems must be separately discussed.

**Willows on meadow or corn land.**—In the first year the rows are hoed about three times and later run through occasionally with a light plow or cultivator. In subsequent years only the plow is used, several times in the season.

<sup>a</sup> For results from close spacing see Forest Service Circular 148, "Practical Results in Basket Willow Culture."

**Willows on bottomland.**—In the first year these are sometimes cultivated once, but as a general thing they are only thoroughly grassed with a sickle. This is done twice in the first season and subsequently but once. As the land is inundated every spring, a heavy coat of mud is deposited, therefore no fertilizing and but little cultivation is necessary (fig. 5). This advantage, however, is partially offset by the stimulated growth of weeds, which are very difficult to keep suppressed.

#### CUTTING.

Unless the holt has been very well tended, the first-year rods may be of little value. They are, nevertheless, cut. As a general rule,



FIG. 6.—Effect of undrained land. Maryland, March, 1903.

however, they are not cut very close, and the projecting head of the set is allowed to stay (fig. 6). This makes the stool branched and knotty from the first—a very serious fault. In the second year the rods of a carefully cultivated holt should have at least half the value of a full crop and from the second or third year the holt should yield at least twelve good, paying crops. Only a few growers realize the value of an occasional rest. As a rule the holt is cut annually until exhausted. Where steam peeling is practiced, the willows are generally cut as soon as the leaves have fallen in November, so that they may be stripped in the winter. In districts where sap peeling is common the rods are allowed to stand on the stump until March,

when they are cut and immediately drafted (fig. 7), tied into bundles, and put into the pit (fig. 8).

By letting the willows stand all winter and cutting them early in the spring, any trouble in housing the rods is saved. In some districts, however, it is customary to wait until the sap begins to run. This is most objectionable, as the stools bleed and lose vitality.

The cutting is generally done with a knife somewhat similar to that shown in figure 9. In almost every district the value of low cutting is fully appreciated, but the work is seldom carefully done in this respect, mainly because of the added expense.



FIG. 7.—Drafting (sorting) willows.

#### DRAFTING AND PEELING.

After cutting, the rods are immediately sorted into four sizes and bundled. This is called drafting, and is most conveniently done in the manner shown in figure 7. An armful of rods is put into a barrel and sorted according to size with a measuring stick. All rods below A go into the smallest size, those between A and B into the next, those between B and C into the next, and all over C into the largest size. About 40 pounds are put into a bundle, which is firmly bound and taken immediately to the pit (fig. 8). This pit is a series of shallow ponds of water, not over 4 inches deep, in which the bundles are stood. Racks are arranged at regular intervals to keep the bundles upright and secure, but they should not be too closely packed. After the willows have stood in the water for two or three weeks the rods

become almost entirely covered with tender, green foliage, while the submerged end is a mass of rootlets. In this condition they are ready for the peeling, which should begin at once. Peeling is done by a man and two strippers, the latter being either boys or women. The brake used for removing the bark (fig. 10, Nos. 4, 5, 6, and 7) is inserted in a



FIG. 8.—Willows in the pit, sprouted and ready for peeling.

beam at a convenient height and the rod passed through it, first in one direction and then in the reverse (fig. 11). This loosens the bark; the strippers then peel it off, either with the fingers or with a dogwood or metallic hand brake (fig. 10, Nos. 1, 2, and 3) and carry the rods to the drying racks (fig. 12), where they are laid in the sun to

dry, care being taken to keep the rods in the four sizes arranged in the drafting. After they are sufficiently dry they are tightly bundled by a machine (fig. 13), and in this form shipped to the manufacturer. The machine here illustrated is not in common use, but from

its simplicity and efficiency should be more generally introduced. It can be made by hand on the place with the aid of a blacksmith. The main feature is the binding strap, which is so crossed on the axle that by turning the latter the pressure is exerted on the rods not only from the top, but also from the sides and underneath. A cog and ratchet

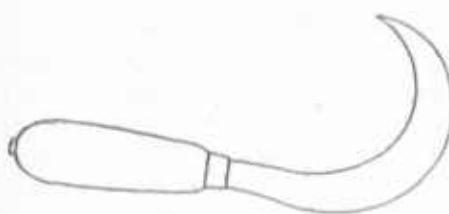


FIG. 9.—Knife for cutting rods.

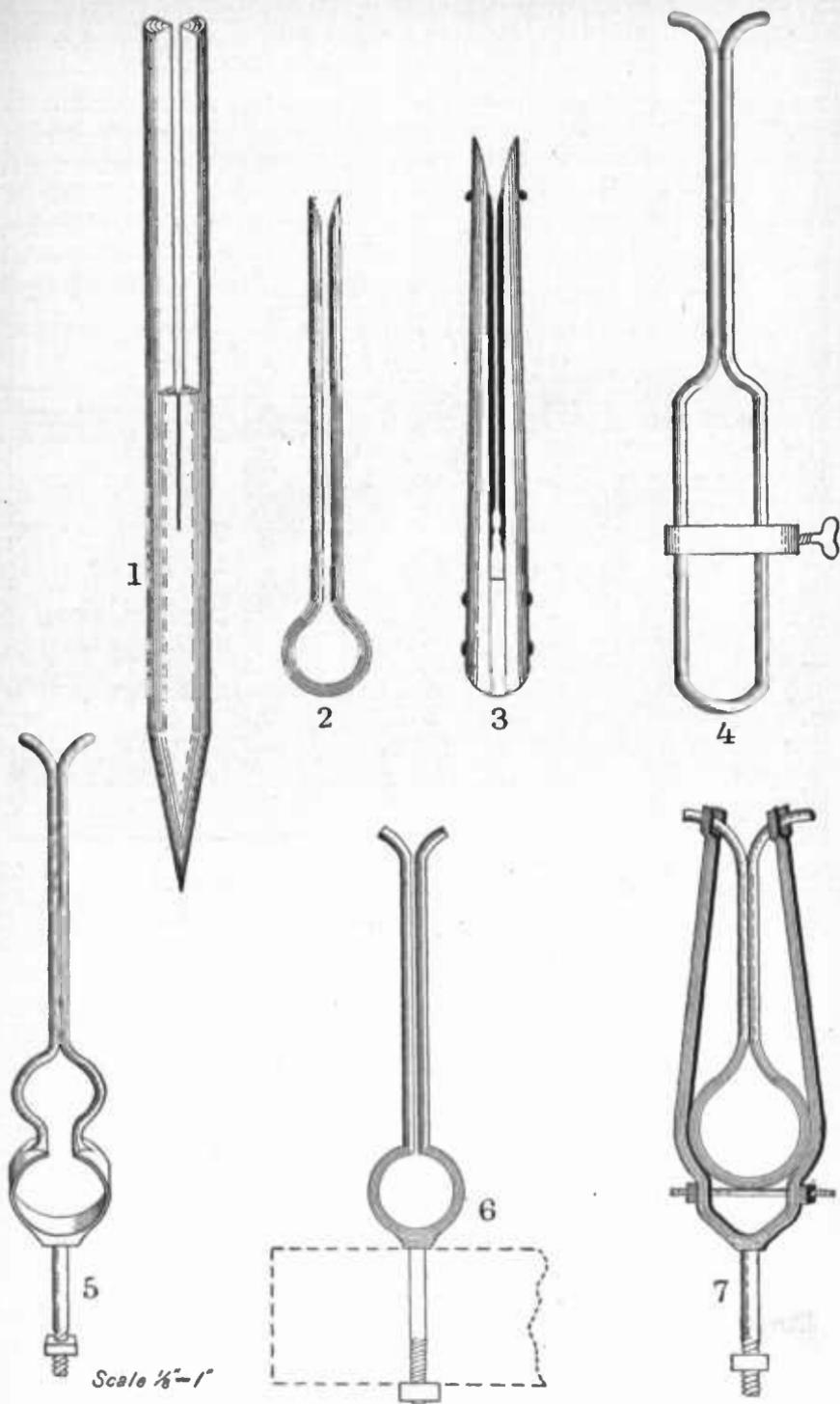


FIG. 10.—Seven types of brake.

attachment on the axle holds the tension while the bundle is being tied; the necessary cord is held in a reel under the machine.

It does not pay to peel the smallest size of rods with the rest, so they are generally put out to families to peel at a given rate per pound, women and children doing the work. The grower makes little or no profit on these rods, but the basket-maker's demand for a certain amount of small stuff makes it necessary to have such stock on hand.



FIG. 11.—Peeling willows in the sap.

### SUGGESTED IMPROVEMENTS IN CULTURE.

The following suggestions concerning willow culture in America have been prepared after a careful study on the ground of actual conditions both here and in Europe. While the introduction of any new system in a particular locality calls for a consideration of questions of labor, market transportation, etc., all of which can not be taken into account in a general discussion, there is room for many improvements on present methods, and the intelligent application by the individual grower of the information here given should enable him in most cases decidedly to increase his profits.

#### CHOICE OF LAND AND PRELIMINARY CULTIVATION.

Any extra expense incurred in the preliminary cultivation of the soil will be repaid in the increased yield. The land should be plowed

and harrowed exactly as for any field crop, and should be fertilized with lime or wood ashes if calcareous constituents are lacking. Even fields subject to inundation should be well cultivated before planting.

If the holt is to be planted on land which is never flooded, the soil should be deep and moist, but not necessarily rich. If the land is subject to inundation in the spring, it should be thoroughly drained. Not only are the rods brittle and of poor quality on swampy soil, but the winter frost forces the stools out of the ground, making large heads above the surface and neutralizing the effect of good cutting (fig. 6).

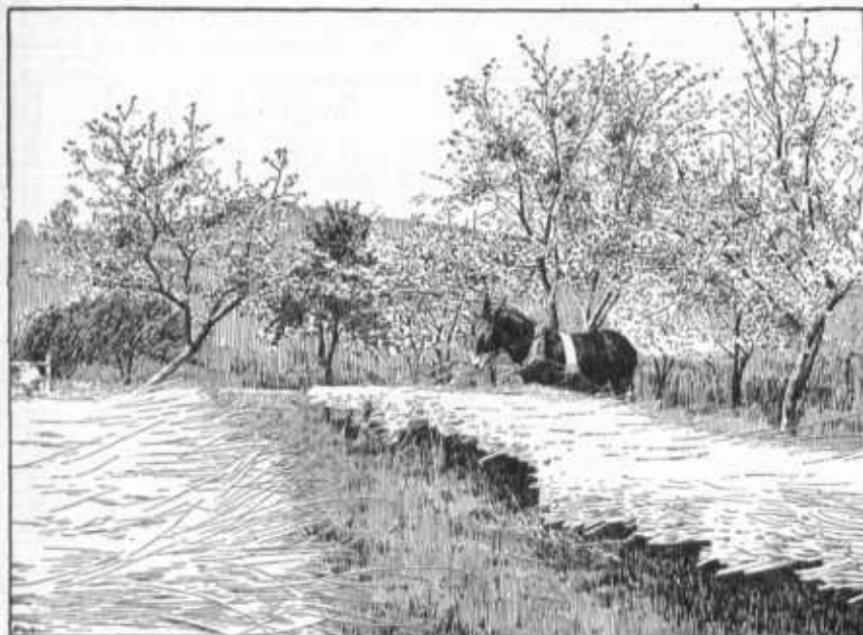


FIG. 12.—Drying the peeled rods on the racks.

There is no doubt that land subject to inundation is the best for willow growing. If it can be perfectly drained and the flooding regulated, ideal conditions are present for the production of high-grade stock. The flooding does away with any need for fertilizer, and the layer of deposit keeps the stools well covered (fig. 5), while if the water stands long enough, the larvae of insects are likely to be killed. All these advantages counteract the additional danger from weeds, which can be kept under if attacked early enough in the season. In a suitable location flooding can be inexpensively provided for by the construction of a weir dam. This would easily pay for itself in the facility with which the water could be regulated. Figure 14 shows a good location for willow growing on inundated land.

## PLANTING.

By planting from 34,000 to 81,000 sets per acre, or at distances from 20 by 9 inches to 16 by 6 inches, both a much heavier yield and longer, more even-sized, and better rods are obtained—straighter, less branchy, and less tapering.<sup>a</sup> (Fig. 15.) The main objections to close planting are the increased initial cost, the greater amount of cultivation necessary, and the more rapid exhaustion of the holt. But the average yield from a holt planted 3 feet by 1 foot after the second year is 4 tons green per acre for about twelve years, while that from an acre planted 20 by 9 inches should not be less than 6 tons green for ten years. This gives the close-planted holt an excess

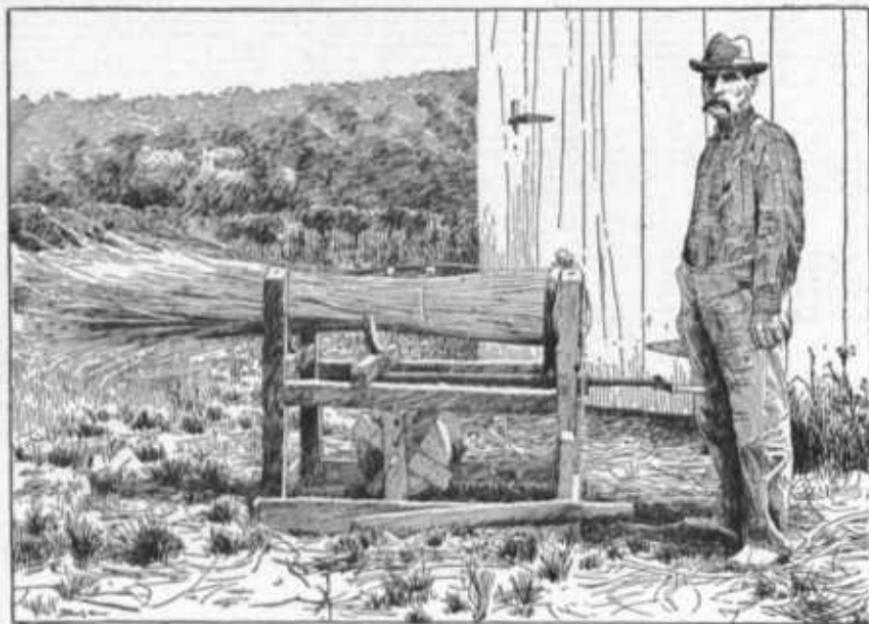


FIG. 13.—Machine for bundling willows for market.

yield of 12 tons over the one planted 3 feet by 1 foot, to say nothing of the extra yield in the first and second years. In Tables I and II the expenditure and return under both systems of planting are given in detail. (See pp. 28, 30.)

These estimates, however, take no account either of the improved quality of the entire crop or of interest on the larger profits secured. With these reckoned in, a much larger balance in favor of close planting would be obtained.

Of course the conditions which determine the application of different methods of willow growing are purely local, and the price of labor and the market for the stock must fix the method of culture,

<sup>a</sup> See Forest Service Circular 148.

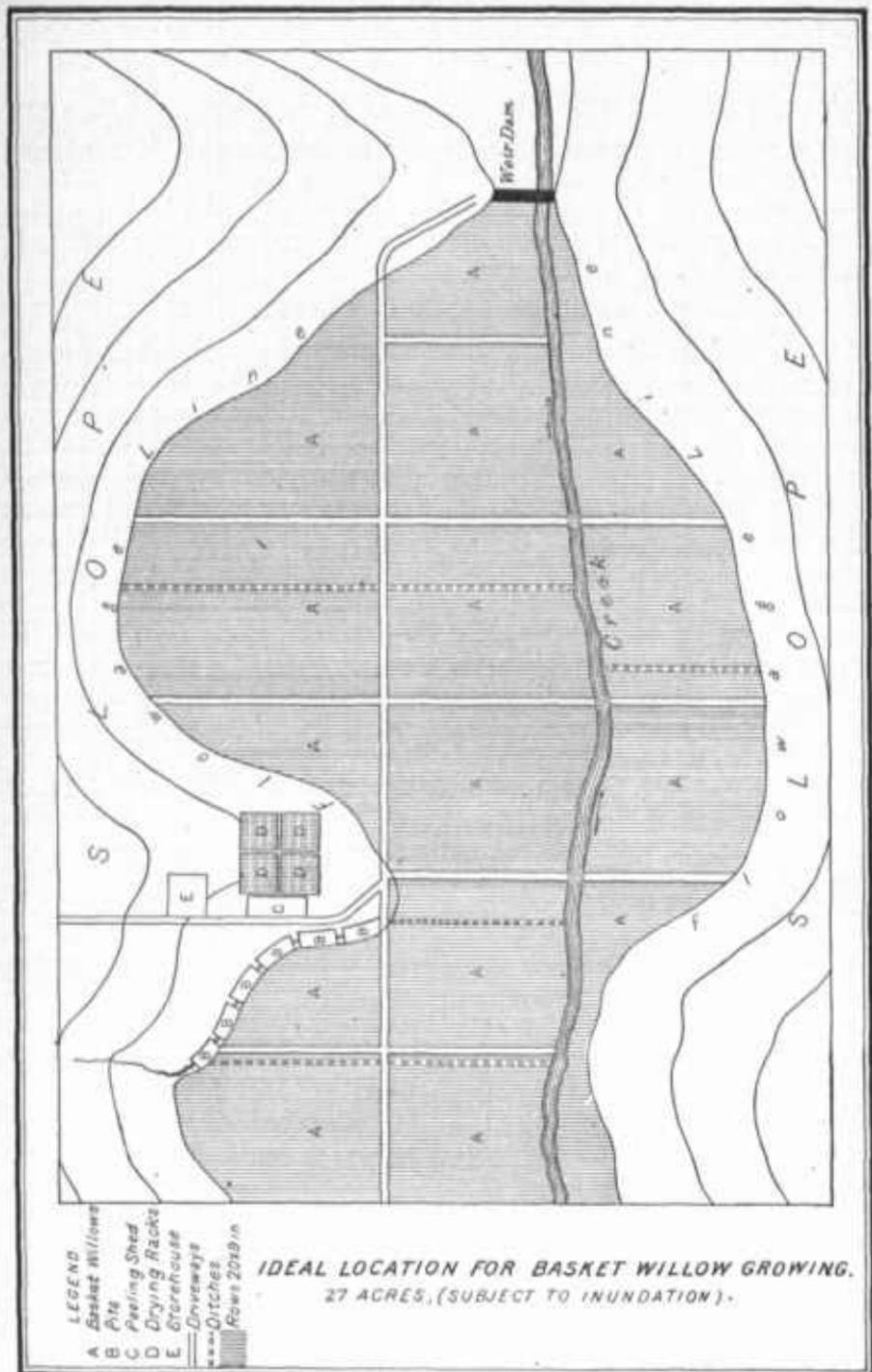


FIG. 14.—Ideal location for basket willow growing.

but if labor can be obtained and the market is thoroughly known, a willow holt will pay as much as any field crop, and possibly more. While in many instances it would not be advisable to change the present method of cultivation, there are places where close planting and careful cultivation would undoubtedly pay handsome returns. For American conditions, 20 by 9 inches, giving about 34,000 plants per acre, would probably be the best distance. Care should be taken that the sets are 12 inches long and planted with the buds pointing upward, and that they are pushed into the ground perpendicularly to within 1 inch of the top.

#### WEEDING AND CULTIVATION.

When willows are close planted it is absolutely essential that weeds and grass, under all circumstances their arch foes, should be kept out during the early life of the holt. Afterwards, when the stools have become vigorous, they are able from their close rank to shade out other plants if the first cultivation in the spring has given the weeds a setback. But in the first year the cultivation should be so thorough that the weeds may get no chance to develop. In normal years three or four hoeings should suffice for this. Two hoeings should be given the second year. After that time one hoeing should be sufficient. The first cultivation should take place very early in the spring, before the stools have begun to sprout, and the soil should be heaped up over the plants. If the ground has been inundated after cutting, the stools will be sufficiently covered, and the first cultivation may be deferred until the weeds begin to start.

Two thorough hoeings under normal circumstances will be found to cost little more than ordinary grassings or other methods of cultivation in vogue, and it is but little more trouble to hoe an acre set with 34,000 plants than one with 14,000.

#### FERTILIZING.

On ordinary soil willows should be fertilized every four or five years, beginning with the fifth or sixth. This makes two treatments during the normal life of a close-planted holt. Any ordinary field manure may be used. If the land is flooded in the spring, no other fertilizing is necessary.

#### INSECTS.

In combating the danger from insects, a first requisite is united action by all the growers of one neighborhood. A few uncared-for holts will completely neutralize all the efforts of careful growers. Against the ravages of such insects as the cottonwood leaf-beetle or caterpillars, spraying with poison is generally efficacious if commenced early enough in the season.

One of the most terrible willow scourges is the willow-shoot sawfly. For this a good remedy is to cut the willows entirely off immediately after the fly has made its appearance, and to be effective this must be done throughout the whole region, even at the sacrifice of a year's crop.

For information in regard to insects affecting the basket willow and methods for their control, application should be made to the Bureau of Entomology of this Department, and it will greatly facilitate correspondence if specimens of the insects accompany letters of complaint or inquiry.

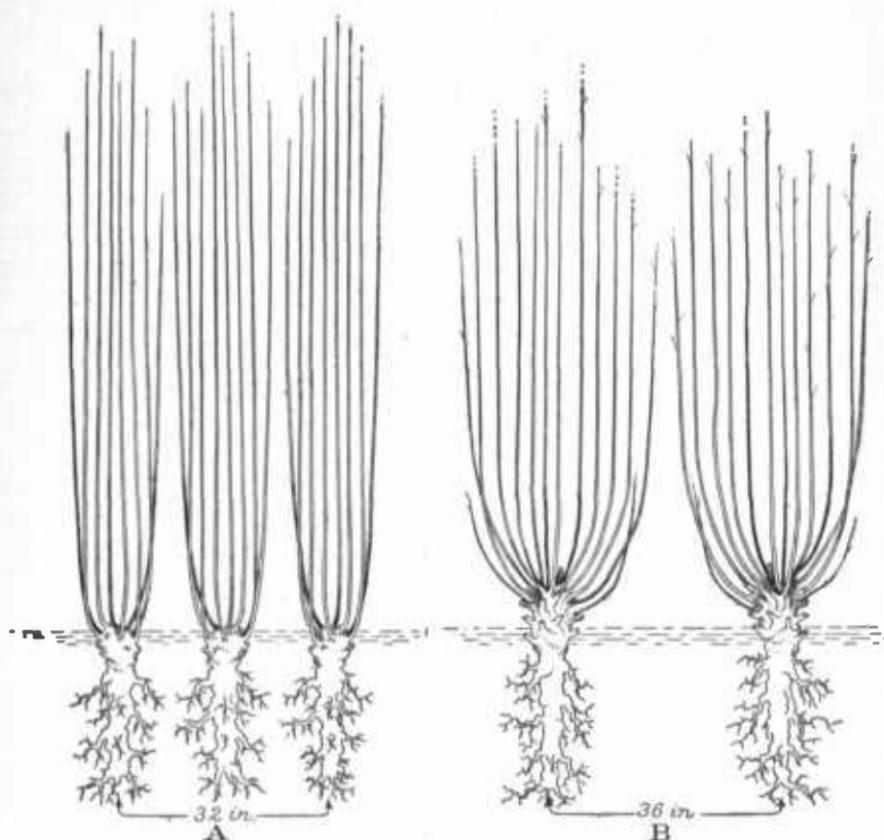


FIG. 15.—Comparison of close planting and good cutting with wide planting and careless cutting.

#### CUTTING.

When the rods are to be steamed, they may be cut any time during the period of rest, but when they are to be sap peeled it saves storage to let them stand on the stools until the spring. Care, however, should be taken to cut them before the sap begins to move.

The necessity for close cutting can not be too much emphasized. The rods should be taken off as close as possible to the stool.<sup>a</sup> Figure 15 shows the difference between good and bad cutting. A illustrates the growth of the rods from a low-ent, compact stool, and B that from a high-branching one.<sup>b</sup>

<sup>a</sup> For the results from later experiments in cutting see Forest Service Circular 148.

<sup>b</sup> Figure 15 is taken from actual examples.

FIG. 16.—Welsh or purple willow ( $\frac{1}{2}$  natural size).



FIG. 17.—Lemley or Caspian willow (natural size).



FIG. 18.—American green or almond willow ( $\frac{1}{2}$  natural size).

After the rods have been cut it is well to go over the holt and thoroughly clean the stools, removing all rods that may have been left. If the holt can be flooded, the water should be let in, covering the stools with a coat of mud.

One of the most successful ways of increasing the holt's vitality is to let the rods stand occasionally for two years. The sixth and the tenth years are good ones for leaving the holt uncut. Many growers think that such a rest makes the subsequent crops brittle, but there is nothing to substantiate such a theory.

#### PEELING, SORTING, PACKING, ETC.

The present system of drafting and peeling can not be much improved, but greater care should be taken in sorting. Almost all basket makers complain of the irregularity of American willow. At present the rods are put into four sizes before they are peeled, and are not sorted after they are white. A second drafting when they are put on the drying racks would be no difficult matter, and would undoubtedly pay. The loss of weight in the hands of the manufacturers comes from too early shipment after peeling, and under present conditions is difficult to remedy. Anything which will make his rods of superior quality should be attempted by the grower. It is to his advantage to have his customers know him for his reliability and the superiority of his stock. If he can establish himself in a sufficiently close relation with them to enable him to work with them for the supply of such rods as are likely to be most in demand, so much the better for grower and consumer alike.

#### EXPENDITURE AND RETURNS IN AMERICAN WILLOW CULTURE.

In estimating the expenditure in willow growing, the holts on farm land and those on bottomland subject to inundation should be considered separately.

##### WILLOWS GROWN ON UPLAND.

In Table I the present and estimated expenditures and returns are given for willows on upland.

TABLE I.—Willow culture on upland.

	A.—Steam-peeled rods as grown in New York.			B.—Steam-peeled rods to be grown 20 by 9 inches apart.			C.—Sap-peeled rods to be grown 20 by 9 inches apart.		
	First year.	Second year.	Third to fourteenth years.	First year.	Second year.	Third to twelfth years.	First year.	Second year.	Third to twelfth years.
<i>Annual expenses per acre.</i>									
Preparation of land.	\$10.00			\$10.00			\$10.00		
Sets.....	a 14.00			a 35.00			b 105.00		
Planting.....	4.50			12.00			12.00		
Plowings, at \$1 each.....	2.00	\$2.00							
Hoeings, at \$3 each.....	8.00	8.00		16.00	\$12.00	\$8.00	16.00	\$8.00	\$4.00
Spraying.....	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00
Cutting:									
Salable rods, at \$5 per ton.....	5.00	10.00	20.00	7.50	20.00	30.00	10.00	20.00	30.00
Left-over rods.....	1.00	1.00	1.50	1.00	1.00	1.50	1.00	1.00	1.50
Drafting, at \$3 per ton.....							6.00	12.00	18.00
Peeling, at \$10 per ton.....							20.00	40.00	60.00
Total.....	48.50	25.00	27.50	85.50	37.00	43.50	184.00	85.00	117.50
<i>Annual returns per acre.</i>									
Willow:									
Green, at \$15 per ton.....	15.00	30.00	60.00	22.50	60.00	90.00	75.00	150.00	
White, at 5 cents per pound.....									225.00
Gross gain.....		5.00	32.50		23.00	46.50		65.00	107.50
Gross loss.....	33.50			63.00			100.00		
Amount of net loss of previous year, with interest at 5 per cent.....		35.18	31.60		60.15	45.30		114.45	51.02
Net gain.....	33.50	30.18	.81	63.00	43.15	1.20	109.00	45.25	55.58
Net loss.....									

a Welsh willow, at \$1 per M.

b American green, Lemley, and patent Lemley willows, at \$3 per M.

Column A is based on the system as practiced in New York State, but should hold good for all regions under like conditions. The sets are supposed to be Welsh willow, and are taken at the usual cost near Lyons, N. Y. While many hols are less highly cultivated, this estimate may be taken as fairly representative of the average expenditures. From the figures it is seen that at the end of the third year the initial expenditure is entirely repaid and a net gain made of \$0.81 per acre. A fair holt will average 4 tons of willow per year for twelve years after the second year. From the fourth through the fourteenth years the gain of \$32.50 in the third year may be taken as an average, giving a profit of \$357.50, or a total profit of \$358.31 per acre for the fourteen years of the existence of the holt. In order to find the net profit for the period the following should be deducted:

Rent at \$5 per acre for fourteen years at 5 per cent.....	\$97.99
Incidental expenses.....	10.00
Total.....	107.99
341	

This leaves \$250.32, or an average net profit of \$17.88 per acre for fourteen years. This estimate should hold good for all localities where willows are steam peeled.

In order to get a greater yield at a lower price the method as given in column B of Table I is proposed. According to German and English experience holts planted 20 by 9 inches yield an average of 6 tons per acre for at least nine years after the third year. Accordingly there is an average profit of \$46.50 per acre (as in the third year), or \$418.50 for the period, amounting to \$419.70 as a total yield for twelve years. To find the actual profit further expenses must be deducted, as follows:

Rent at \$5 per acre for twelve years at 5 per cent.....	\$79.59
Fertilizer.....	10.00
Incidental expenses.....	15.00
Total.....	104.59

This leaves \$315.11, or an average of \$26.25 per acre for twelve years, as compared with \$250.31, or an average of \$17.88 per acre for fourteen years, obtained by planting 3 by 1 feet, as at present. A careful study of the items in column B will show that each cost estimate is an extreme figure, while the yields given have been found only a fair average in England and Europe, where many holts give 8 tons per acre as a regular average.

If the grower of willows on upland intends to peel his stock in the sap, he should select American green, Lemley, and patent Lemley as well as Welsh willow. The sets of the first-named varieties cost about \$3 per thousand at present. The results under close planting would be as given in column C. At a gain of \$107.50 per annum, \$967.50 will be realized from the fourth to the twelfth years. Including \$55.58, the gain in the third year, a total of \$1,023.08 is obtained.

The following additional expenses per acre must be deducted:

Rent for twelve years at \$5 per acre at 5 per cent.....	\$79.59
Fertilizer.....	10.00
Incidental expenses.....	15.00
Total.....	104.59

There should thus be a net profit per acre of \$918.49, or \$76.54 per year for twelve years.

#### WILLOWS GROWN ON LAND SUBJECT TO INUNDATION.

It is a noticeable fact that the best willow raised in this country, and that which commands the highest price, is grown on well-drained bottomland in Pennsylvania and Maryland. The actual methods of culture are, if anything, less intensive than those in other districts; yet the willow is less subject to insect damage, is better grown, and is generally of a finer quality than elsewhere. This is only in small

part due to the use of better varieties (American green, Lemley, and patent Lemley); it may be almost wholly ascribed to the fact that the land is subject to overflow in the spring. This acts as fertilizer, and builds up the soil about the stools.

TABLE II.—Willow culture on bottomland subject to inundation.

	A—Sap-peeled rods as grown in Maryland.			B—Sap-peeled rods to be grown 20 by 9 inches apart.		
	First year.	Second year.	Third to fourteenth years.	First year.	Second year.	Third to twelfth years.
<i>Annual expenses per acre.</i>						
Share of \$200 dam.				\$10.00		
Preparation of land.	\$25.00			25.00		
Sets.	42.00			105.00		
Planting.	5.00			14.00		
Mowings:						
Grazing, at \$8 each.	16.00	\$8.00	\$8.00			
Vines, at \$2 each.	2.00	2.00	2.00	2.00	\$2.00	\$2.00
Hoofings, at \$4 each.				16.00	8.00	4.00
Cutting:						
Saliage rods, at \$5 per ton.	5.00	12.50	20.00	10.00	20.00	32.50
Left-over rods.	1.00	1.00	1.50	1.00	1.00	1.50
Drafting, at \$3 per ton.	3.00	7.50	12.00	6.00	12.00	19.50
Feeling, at \$10 per ton.	10.00	25.00	40.00	20.00	40.00	65.00
Total.	100.00	56.00	83.50	200.00	83.00	124.50
<i>Annual returns per acre.</i>						
White willow, at 5 cents per pound.	37.50	93.75	150.00	75.00	150.00	243.75
Gross gain.		37.75	66.50		67.00	119.25
Gross loss.	71.50			134.00		
Amount of net loss for previous year, with interest at 5 per cent.		75.08	39.20		140.70	77.39
Net gain.	71.50	37.33	27.30	134.00	73.70	41.86
Net loss.						

In Table II, column A shows as accurately as possible the present cost of growing in Maryland. The rent has been taken at the normal price which should be paid for bottomland in brush. It was found in many cases that willow growers were paying for ground otherwise useless a rent which could hardly be obtained for the best truck-gardening sites. Such a state of affairs had come about in consequence of making short leases or renting from year to year. Once the land was cleared and in willows, growers would pay many times what they should rather than change or go out of business. Such conditions should not be considered in a normal expense account. From the present method of growing, a profit of \$66.50 is made in the third year, as given in column A. The same will hold good for the next eleven years, giving \$731.50 for the period, or a total of \$758.80 from the acre. Deducting from this fourteen years' rent, at \$3 per acre, amounting at 5 per cent compound interest to \$58.80, and \$15 for incidental expenses, a net profit of \$685 is obtained, or \$48.93 per acre per year for the fourteen years of the holt's existence.

The superiority of willows grown on bottomland has been explained as due to the greater uniformity of moisture and the value of the annual deposit of sediment. For this reason the building of a dam to regulate the water supply and drainage is urgently recommended on every willow plantation of any considerable size. In column B the figures are calculated on a basis of 27 acres and the cost of the dam included. Estimating after the manner of the preceding columns, the total return from the acre in twelve years will be \$1,115.11. Subtracting \$47.75 for rent, at \$3 per acre for twelve years, with compound interest at 5 per cent, and \$20 for incidentals, there is a net return per acre of \$1,047.36, or \$87.28 per acre for twelve years.

#### SYSTEMS OF PEELING COMPARED.

In comparing the two systems of peeling at present in vogue in America, a great difference in returns appears between willows grown for steam and for sun peeling. Practically the entire amount of steam-peeled willow comes from New York. It seems strange that the district which produces nearly half the value of the entire production in America, and three-quarters of the actual amount grown, should resort to a cheap method when other districts get nearly four times as much for their willows. Yet the matter is more simple than it seems. New York is the center of an old industry, where there is no skilled labor, and the willows are steam peeled to help make a cheap product. The product of Maryland and Pennsylvania is sold to the makers of fine baskets and furniture, and competes with the imported French willow. Hence it must not be forgotten that the market for willows grown according to the estimates in Table I is much larger than that for the estimates of Table II. The market for willows which yield at present over \$50 an acre is a limited one, and if many growers take up the new system, which is estimated to give a return of \$87.28 per acre, they must count on a speedy fall in the price of raw willow. Yet the margin between \$87.28 an acre and \$50 an acre is amply sufficient to allow a substantial fall in price and still give the grower a better profit than he can now make by the present method of culture. Such a condition is exactly the ideal to be striven for. If fine willows can be raised profitably at 4 cents a pound, there is an import trade of nearly \$40,000 to be captured, together with the increase in the basket output which would follow a reduction in price of the raw material. These facts should convince the willow grower that it is to his advantage to take up the new method, and in the increased yield per acre and superior quality of the stock to make a profit greater than that possible by his old method at a lower market price per pound. In practice the advantage of bottom over meadow land would be even greater than shown in Tables II and III. The highland willows must be regularly fertilized

and the earth banked about the roots. They are subject to drought and to insect ravages, while those grown on land which is regularly inundated can be kept in better condition. For these reasons the average crop has been set at  $6\frac{1}{2}$  tons, a figure which results will certainly justify.

The increase in yield by the new system is proportionately the same for willows intended for sap and for steam peeling, and the choice of methods must depend entirely upon the local market or other conditions.

#### FIELD EXPERIMENTS OF THE FOREST SERVICE.

In the seasons of 1903 and 1904 experimental plats of basket willows were set out on the Government experimental farm at Arlington, Va. The holt, which at present covers 66 square rods, is situated on rich Potomac bottomland. The American green, patent Lemley, Lemley, and Welsh willows are planted 18 by 6 inches, 20 by 9 inches, and 36 by 12 inches apart. The object of establishing this plantation is to determine the proportionate yield for these willows under different systems of spacing and under similar soil conditions.



A number of new varieties were brought from Europe and planted here during the

spring of 1908 for the purpose of increasing the varieties of basket willows suitable for cultivation in this country. Each variety will be planted in several spacings, as above indicated, to determine the effect of close and wide spacing on the yield and on the life of the holt. The effect of low cutting on the yield, character of the rods pro-

duced, and vitality of the stools, both in close and wide planting, will also be noted, together with many other important considerations to be included in these experiments. Careful study will be made of the proportion of wood to bark and of the comparative weight of the peeled and dried rods for each species, variety, and strain.

A number of experiments have been completed already and the results published. The results of other experiments will be published from time to time for the benefit of those engaged in basket willow culture.

A part of the willows grown each year is distributed, in the form of cuttings and free of charge, to farmers and others desiring to establish basket willow hols.

## WILLOWS FOR GROWING IN AMERICA.

The qualities required to constitute a perfect rod are extreme toughness, elasticity, a level, smooth, and brilliant white surface after peeling, good splitting quality, freedom from branches, great length of shoot in proportion to thickness, and a small pith. The development of a species which will produce such rods and which at the same time is hardy and not liable to ordinary diseases, and a good cropper, is the end for which growers should strive. This demands that the greatest care should be exercised, not only in the choice of species, but also in methods of culture. Good varieties give no results under careless methods; even inferior kinds will pay if well tended. It should be the object of every grower to lower the price and better the quality of his willow, for on this depends the future success of American willow culture. If rods equal to the French and cheaper in price can be put on the market, there will be an opportunity for a great expansion of basket and furniture manufactures, and the growers will more than make up in larger sales what they lose in price per pound.

Of the 92 varieties of willow and hybrids known to European culture, the only ones extensively planted in this country are: The American green or almond willow (*S. amygdalina*), the purple or Welsh willow (*S. purpurea*), and the Caspian or Lemley willow (*S. pruinosa acutifolia*). It is worth while to describe these in some detail.

(1) The almond willow (*Salix amygdalina*, fig. 18) is the most widely cultivated willow in the north of France, and is much used in England and Germany. The growers in Maryland and Pennsylvania also grow it under the name American green. The wood is strong and heavy, so that basket ware made from it is very durable—an important point in competition with rattan. It is also easily bent, tough, and not difficult to split, and its color is a brilliant white. Yet it is just as easily used for coarse work as for fine, and for "brown" or unpeeled as for peeled basket ware. Some of the shoots are heavy enough to be used for the heaviest baskets; others are good for fine workmanship. Although the almond willow prefers a heavy land, it does well also on sandy soil. It demands, however, a soil full of nourishment. It has the heaviest foliage of all willows. This great leaf area makes vigorous growth possible, and in the fall covers the earth with litter. Consequently weeds have the least chance to grow, while the heavy shade keeps the ground fresh and unburnt. One of the most serious faults of this willow is a tendency to branch, a peculiarity of certain other varieties in varying degrees, and which may be reduced to a minimum in all cases by close planting. It is also more sensitive to damage by hail than any other willow, wart-like excrescences or black spots forming on the places struck by hail-

stones. It is cultivated in Maryland, Pennsylvania, through Indiana, Ohio, and Kentucky, and as far as Illinois, and everywhere is in high demand, especially for furniture.

(2) *Purple or Welsh willow* (*Salix purpurea*, fig. 16).—This is perhaps the most beautiful of all the willows. It produces a large number of supple, slender, and even-sized shoots, with no tendency to branch. It grows slowly, however, and never attains a great size. The rods are very difficult to peel, and the wood is extremely hard, of a bad color, and not easily split. The ground most suited to its growth is a fresh sandy loam with considerable humus. On heavy land it does poorly. The purple is the hardiest willow known. Cold and heat, wet and excessive drought—all these extremes have less effect on its



FIG. 20.—First-year rods of common white willow from newly planted sets. Germany, November, 1902.

growth than on any other basket willow. It is also a good cropper; hols have often been cut forty years. It is the most commonly grown willow in America.

(5) *Lemley and patent Lemley, or Caspian willow* (*Salix pruinosa acutifolia*, fig. 17, and variations of the same).—The Lemley has been much recommended for planting on sandy soil, where it is said to do better than any other willow. It is a serviceable species and gives good rods, which peel well and are white. As it sends out very few rods from a stool and has a tendency to branch, it should be planted in close order. With its hybrid, the patent Lemley, it is common and highly valued in parts of the willow-growing district of America.

## MANUFACTURE OF WILLOW WARE IN THE UNITED STATES.

### GENERAL REMARKS.

In Europe to-day every grade of basket, from the finest to the coarsest, is made of willow, and of almost nothing else.<sup>a</sup> The heaviest farm baskets and receptacles used for handling rough merchandise are made out of unpeeled willow, and from this its use extends through all the grades of basket ware—peeled willow market, clothes, and fruit baskets, furniture, hampers, and trunks, to the finest examples of split willow ware, wrought with a skill which gives them a real artistic value.

In America the market has a different aspect. Here a very large number of baskets are made of wood, some of woven pine, oak, ash, and elm strips, others constructed from broad veneers laid together at the bottom and fastened at the rim by a strip. Market, clothes, and laundry baskets are largely made of wood, and the willow is forced to be content with a limited share of the general trade. Rattan, too, has always enjoyed a high degree of favor, and has a permanent place in the American market. Baskets made from wood other than willow are much less durable and have not the combined lightness and elasticity which is so desirable. Rattan is quite as lasting as willow, but it is less rigid, and its rough surface soils quickly. It is also much more expensive.

On this continent, where economy of labor is of the first importance, the manufacture of those baskets intended to be filled but once, such as fruit baskets, etc., forms a class by itself, which lies necessarily entirely outside the field of the willow. In this case cheapness is the only essential, and the preparation of the material is entirely done by automatic machinery, while the hand process of manufacture is the simplest imaginable. A recent machine has entirely supplanted hand labor and reduced the cost.

### WICKER FURNITURE.

For many years huge quantities of rattan have been used in the manufacture of furniture. In consequence a high degree of skill has been evolved, and the designs have become more and more elaborate. Willow is less easy to work, the result being that furniture made from it has greater simplicity of design. This, together with its durability, lightness, and beautiful color, has brought it into popular favor, and many important manufacturers have given up rattan entirely and gone over to willow. As a consequence the output has increased more than 100 per cent in the last ten years.

<sup>a</sup> A very small quantity of wooden-strip baskets is manufactured in Sweden and Norway.

The manufacture of willow furniture requires a high degree of skill. (Figs. 21-22.) The lower cost of the willow is neutralized by the greater difficulty in working it, so that the two kinds of furniture enter the market on equal terms. Willow furniture is also made in Europe, but it is bulky and the transportation is very costly. As a result the import is not worth considering.

The industry in America is centered in New York and Boston. There are small concerns in various other places, but all the wholesale supply comes from a few large houses in these two cities. Wages are as high as \$20 a week, but most of the workmen are foreigners; few young Americans adopt the trade, although really first-class men can always find work even at \$3 per day. If the industry increases as it

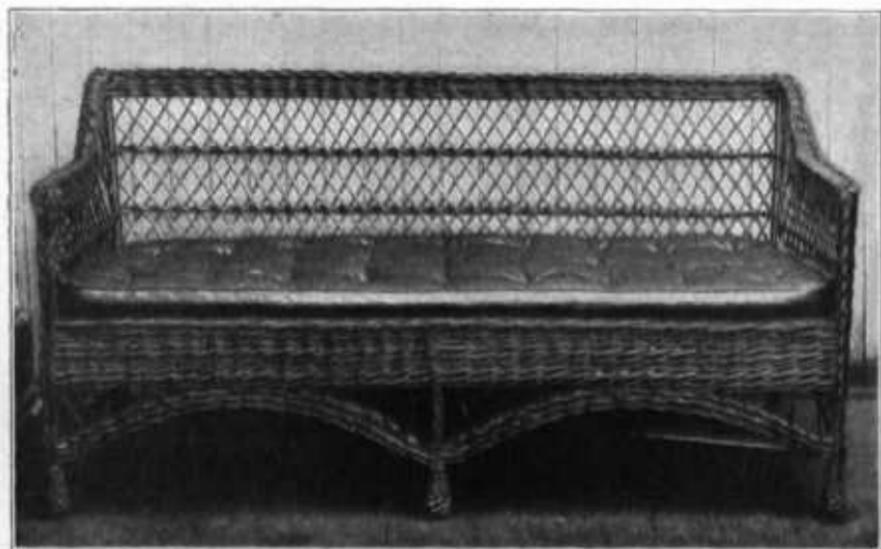


Fig. 21.—High-grade willow furniture.

gives promise to, one of the greatest problems will be that of skilled labor.

Yet the question of the raw material is of even greater economic importance. At present all furniture makers use far more French willow than they do American. There are several reasons for this. The French willow is of a much more beautiful color, and is better sorted and easier to get in small sizes. The American is sorted and packed with less care, and the rods are apt to be large, the average grower not appreciating the value of small stock. The latter is more difficult to peel, and consequently more expensive to produce. As a result it is generally discarded, although there are growers who supply small rods at cost price just for the sake of the trade.

The average price for French willow is about 7 cents per pound. American willow of the best quality comes in four sizes, and is sold at from 5 to 7 cents a pound. The smallest size is hard to get, and the other sizes are not satisfactorily sorted.

Remembering that American willow is favorably looked upon by furniture makers and that most of their objections can be removed by greater care in its culture, every effort should be made to obtain possession of this most favorable market.



Fig. 22.—High-grade willow furniture.

#### HIGH-GRADE WILLOW BASKET WARE.

The makers of high-grade willow basket ware are generally in the larger cities. Through thrift, industry, and perseverance they have built up a regular custom trade. (Fig. 23.) Their establishments are found throughout the North, from the Atlantic to the great cities of the Mississippi. High wages in the far West make it more profitable to buy in the East, although there are several establishments in San Francisco and Sacramento. In the South, where large cities are

fewer, such basket makers are to be found only in Richmond, Charleston, and New Orleans.

Almost without exception these workmen make no attempt to compete with the manufacturers of cheaper baskets, and confine themselves entirely to the production of goods for their particular customers.

One of the most serious questions which this phase of basket making must contend with is labor. Even in New York and Boston difficulty is found in getting good men at the wages which the basket maker can pay, and the farther west one goes the greater is the lack of good hands. The men available are nearly all foreigners, mostly Germans.



FIG. 23.—High-grade willow ware.

Occasionally American-born workmen are to be found, but the long hours and comparatively small wages (\$2 a day is a maximum) drive young men into other and more attractive fields. Throughout the country there is many a master basket maker who could enlarge his trade if he could secure more labor. As it is, he must be content to hold what custom he has.

The source of supply of raw material varies in different parts of the country. In the East both foreign and domestic willows are largely used. The large furniture makers of Boston and New York also manufacture baskets, and for their best wares use French stock. This

is done for the same reasons as those given in the case of willow furniture. Nevertheless they all use American willow and say they would use more if they could buy it, as it is heavier and more durable than the French. All willow used for fine baskets, and still more so for furniture, must be brilliant white, and for this reason only sap-peeled rods are to be considered. The foreign willow at present has a better color, but for basket ware American sap-peeled willow is white enough, and if it is properly sorted, not branchy, and with long, straight rods, it answers every purpose of the trade.

There is no reason why the custom trade of the great eastern cities should not be supplied by home growers who take the time to improve their methods. Baltimore is the seat of a large number of expert basket makers, who are almost entirely supplied by the willow growers of the neighborhood. Richmond is supplied by an establishment which has taken the wise step of growing its own willows, and with the most gratifying result. Indeed, these two cities, with their supply of raw material near at hand, are able to ship high-grade baskets to other parts of the country, and afford a very instructive example of what may be done in this line.

As one travels farther west the transportation cost raises the price of foreign willows, so that even in Cincinnati it stands at 7 to 8 cents a pound. As the best native stock of the neighborhood costs but 6½ cents and lower grades only 4 or 5 cents, it needs only quality to command the field. In Indiana, Ohio, and Kentucky the question is entirely one of better growing and a successful contest with dangerous insect pests. A few years ago the best willows sold at 3 cents a pound, but now can hardly be bought at 6. Some of the larger basket makers in St. Louis use French rods, but the vast majority of the stock comes from the neighboring willow-growing States. Chicago is supplied with a very good willow from Wadsworth, Ill., and from Indiana and Kentucky. The same is true of Milwaukee and other cities in the same district. One and all, the basket makers seem to prefer the American willow if it can be obtained.

The custom-made basket has a steady market throughout the country. If the basket maker can get good stock at a low price, there is no doubt but that he can enlarge his trade. For this reason there is a promising outlook for scientific willow culture.

#### LOW-GRADE WILLOW BASKET WARE.

The best quality of willow basket, it has been seen, has scarcely a competitor in the field. The demand for such goods, however, is comparatively limited. The great mass of the population are either unable or unwilling to pay a high price for household basket ware. It is to satisfy this demand that the wooden basket exists and has so large a sale. Nevertheless willow is known to be so superior to it for hand

baskets, clothes baskets, hampers, etc., that people will buy it in preference if its price reaches a figure which represents, in comparison with the cheaper forms of basket ware, the ratio of durability between the two. To bring prices to this level has been the attempt of a large section of the basket-making population for many years, and upon them alone falls the brunt of the competition with wooden baskets, and also with the cheap willow product imported from Europe.

In order to gain a clear view of the situation, it is necessary to divide the manufacture of cheap willow baskets into two sections. The first of these is the wholesale basket industry in western New York State and the second the manufacture of cheap baskets in small isolated establishments in the great cities and throughout the country.

The basket industry about Syracuse, Rochester, and other western New York cities is different from that in any other part of America, and more nearly approaches that of certain sections of Europe. It is centered in the midst of an important willow-growing district, and is mainly in the hands of a few large dealers. These men buy the willows and give them out to the basket makers, who make them up into baskets at home, receiving a specified sum per dozen, according to size. The principal object in view is cheapness, and everything is done to reduce the cost to a minimum. The willows are steam peeled, a process which very much reduces the price, but which turns the rods a red-brown color and ruins them for all manner of fine work. There is no doubt whatever that it is European competition which sets the price of this basket ware, and which has reduced the New York basket industry to such a low margin of profit that its very existence is threatened. Certain large importing houses in New York have buyers continually in Europe, who procure large quantities of cheap wares at every opportunity. These baskets can be compactly stored and shipped at low rates, the import duty paid, and the goods put on the American market at a phenomenally low price.

The competition of the foreign basket is illustrated by the case of the willow growers and dealers of Syracuse, who about fifteen years ago, favored by the cheap price of willows, formed themselves into a stock company and began to assume control of the trade in America. Immediately the importers bought up a large stock of cheap baskets in Europe, underbid the American combination, and deprived them of their sales. The large number of baskets left over in the warehouse at Liverpool was set on fire—probably by those who feared for their next year's work—and since that time no attempt has been made at combination. To make matters worse, at that time the willows were sadly devastated by insects and the price of the raw material was consequently very much increased.

Although the import of foreign baskets sets the price of the American-made product, this import itself is not a growing one. The whole

consumption of basket ware in America is not increasing, and besides, the foreign basket, to sell at so small a price as it does, must necessarily be of very low quality. For this reason it has lost favor, and the American basket is beginning slowly to assert itself. Certain basket makers even in the New York district sell their product for much more than the European basket ware brings. This is an approach to the class of the high-grade basket, but as yet the tendency is not marked; the great mass of the workmen are in active competition with the European product, because, even if it is not largely imported, it is always overhanging the market and preventing any rise in price. Nor is this the only depressing force which the cheap American basket must face in seeking a market. Certain grades of wooden baskets actively encroach on its field. Huge quantities of covered hand baskets are made of splints at a very low cost, and have a large sale. A wooden "satchel basket" can be bought for 70 cents, while a willow one of equal capacity costs \$1.25 to \$1.50. The willow basket is much more durable than the wooden one, but not enough so to make up for the difference in price. This is the case not only with hand baskets, but also with clothes, market, and bushel baskets. It may safely be said that the entire decrease in the willow basket output since 1890 has gone to swell the sales of the same article made of wood.

Nevertheless, the cheap grade of willow basket has a regular place in the market, and one necessary to the general trade. A reduction in the cost of the raw material would allow the dealer to pay a better price for making the baskets. Nor need this reduction in the cost of the raw material be carried out at the expense of the farmer. More scientific methods, a greater yield per acre, and a better knowledge of his market will give him a larger profit on his willows in the increased demand.

Although nowhere else is there so large a center as in western New York, there are basket makers scattered through the country districts of Pennsylvania and the Middle Western States as far as the Mississippi. These work under very much the same conditions as their colleagues in New York, using, as a rule, however, sap-peeled willow. Apart from a small sale in their neighborhood they all sell to the nearest large city, and here they invariably meet the French or German basket on sadly unequal terms. In Cincinnati, for instance, the large dealers can afford to sell a "nest" of four foreign baskets (three pecks, a half-bushel, a trifle more than a peck, and a half-peck) at 64 cents, while the American maker loses money by selling better made baskets for less than 90 cents, although he is compelled to sell at this price if he sells at all. Thus it is throughout the country.

In all the large towns small basket makers are found who sell low-grade baskets at a very low price. They are almost always foreign-

ers who live in the simplest way and in the smallest space possible. Their material they obtain as cheaply as they can, and with the help of their whole families and by working long hours they are able to produce baskets which they sell in their neighborhood or peddle in the streets, probably making a very good profit. From this laborious, frugal class of foreigners have come nine out of ten of the successful, well-to-do master basket makers.

#### SUGGESTIONS FOR BASKET MAKERS.

In Europe basket ware is used for many purposes practically unknown in this country. In dairies and bakeries on the Continent and in England, eggs, buns, rolls, etc., are displayed in very delicately woven shallow baskets of the finest kinds, which are very beautiful and make the store much more attractive than ordinary vessels. Grocers often use willow hampers for dried fruits, nuts, etc. The hampers are made with one side higher than the opposite, so that the wares can be better seen. The hamper is set on short feet to keep it off the ground.

In England great quantities of split willow ware are used. Screen doors and office window screens are beautifully fashioned in willow, and even hotel washstand splashes are made out of the same material. Beautiful little mats for hot dishes at table are also made from split willow, to say nothing of very dainty bread baskets.

A half-bushel basket is made in England and Holland which is singularly durable for its weight. The bottom is arched, giving the whole basket great strength. Nurserymen ship their trees in baskets of unpeeled willow, the uprights of which project from the basket and are tied together over the top of the plant for its protection.

A very beautiful and light basket is made in Germany, with the sides formed simply of uprights strengthened by one or two single lines of weaving.

In England commercial travelers' sample boxes are made of willow, lined with waterproof leather or canvas, the corners and edges bound with rawhide. These trunks are very light, and are serviceable enough for almost any usage. Laundry hampers are also made on the same principle. Parcel trucks on the English railways are almost always of willow, and seem to render perfect service. Willow trunks and hampers are a feature of European traffic, and their use, particularly for suburban transportation, might become more general here.

#### SUMMARY STATEMENT.

The growing of basket willows was introduced into the United States some sixty years ago by German immigrants who settled in New York and Pennsylvania. The industry was soon extended to

Maryland and westward to Missouri and Iowa; it is now rapidly spreading over the nonarid regions of the far West. This industry, which has been languishing for a number of years, has recently taken a sudden leap and shows enormous possibilities. This is due entirely to improved methods of culture and to the introduction of new and choice varieties of basket willows. The cost of production in the United States has been greatly reduced, while the quality of the rods has been improved. These results have brought a betterment of the condition of both the grower and the manufacturer.

In summarizing the essential considerations of this industry, it is important to call attention particularly to the specific instructions given in the bulletin regarding the planting, cultivating, harvesting, and marketing of basket willows. General instructions do not always apply to the special needs of some growers. Many details can be learned only by experience.

**Soil and situation.**—Great care should be taken in the selection of the soil and the location of the holt. Rich, permanently moist, sandy loam gives best returns, though ordinary moist sandy land often yields profitable crops of willows. Poor soils produce paying crops where there is a market for short rods. Avoid land on which water is stagnant during the summer. If by drainage the water level on such land can be lowered at least 6 feet below the surface, the situation may be considered appropriate. Do not plant willows in localities where early frosts occur. The tender shoots are easily injured by cold.

**Preparing the ground.**—Plow 10 or 12 inches deep in the fall, prior to planting the following spring. This turns the top layer of the soil so deep that weed seeds can not spring up. If rain is insufficient, irrigate the holt, if possible, but thorough drainage must be provided, as water must not stand on the surface. It is best also to keep the land well drained during the winter.

**Variety and quality of willows.**—Returns depend very largely upon the method of culture, but more upon the variety of willow planted. Willows with the most approved qualities should be planted, because the shoots of even the best varieties and in the most suitable soil grow brittle after the stools become old. The American green and Welsh willows are most generally planted. The rods of the former peel readily, split easily, are snow-white, hard, flexible, and heavy. They have a tendency to branch, however, and unless the stools are planted close together, a large percentage of the rods branch so much that they are often unfit for peeled stock. The Welsh willow yields less in bulk per acre than the American green, but surpasses the latter both in market value (because of better quality) and in specific weight. For planting along rivers to prevent erosion, Welsh willow is the best. The Lemley, or Caspian willow, is prefer-

able for planting in poor, sandy land. In moist, rich, sandy loam it produces more than twice as much in weight as the Welsh willow. It is best to plant several varieties of willows in order to obtain a good crop of one or more each year, since all willows yield better crops some years than in others.

A good basket willow possesses the following characteristics:

- (1) Ability to yield an annual and uniformly paying crop of rods.
- (2) Flexibility.
- (3) Productiveness, i. e., many shoots to each stool.
- (4) Slender and branchless rods.
- (5) Smooth and white wood after peeling.

**Planting willow cuttings.**—Cuttings for planting should be made from one-year-old shoots. The length of the slips is regulated by the condition of the soil. The richer the soil the shorter the cuttings may be. Generally they are made 8 inches long for moist, rich soil, and 12 inches for dry, sandy soil. Although it is generally advised to prepare cuttings just before planting, they may be made several weeks in advance and, partially buried in moderately moist sand, stored in a cold barn until needed. Bury the cuttings in sand to within 1 inch of the top. Care should be taken to have the buds point upward.

Plant early in the spring, as soon as the frost is out of the ground. In spacing the plants, the following principle holds for all willows and for all soils: The closer the cuttings are planted, the more valuable, i. e., more flexible, tough, slender, and branchless the rods become. On the other hand, they must not be planted so close that the soil in and between the rows can not be cultivated. As a general rule, cuttings should be spaced 9 inches apart in the rows and 20 inches between the rows. Willows with small leaves should be planted 6 by 18 inches or 5 by 15 inches apart. Otherwise they are likely to branch too much.

The number of cuttings required to plant an acre is as follows:

Distance apart in the rows.	Distance between the rows.	Number of cuttings per acre.
Inches.	Inches.	
5	15	83,635
6	18	58,080
9	20	34,846

**Cultivating the holt.**—The success of a plantation depends largely on sufficient soil moisture, freedom from weeds, and permanently loose soil. Cultivate early in the spring and as often as necessary to remove all weeds and to keep the soil loose. If this is done well for the first two or three years, there will be very little trouble with

weeds thereafter, because the weeds are completely shaded out by the dense leaf development. Bind weeds and wild morning-glories are very troublesome in most holts, and must be removed. The holt can not be cultivated too often so long as the stools and shoots are not injured by the cultivator.

**Harvesting the rods.**—The best time for cutting the rods is between November 15 and February 15. Rods from one-year-old holts should be cut at the end of the first year, preferably when the ground is frozen. During the first year the root system is small and care must be taken in cutting not to pull up the stools. Keep knife sharp and make the cutting strokes clean and decisive. Cut close to the stools—but not into them.

Rods to be peeled are stood on end in a pit containing water from 4 to 6 inches deep and kept there until the sap rises (the buds open and leaves appear), when the bark can be removed. The peeled rods are quickly bleached and dried when exposed to the sun, after which they are sorted, tied in bundles, and stored in a dark, dry place. Frequently willow rods are steamed or boiled in water for three or four hours as a means of preparing for peeling, a method which loosens the bark and renders the peeling easy. Boiling or steaming gives the rods an undesirable dark buff color which makes them less valuable.

Rods are peeled by drawing them through a springy wooden or steel fork, shaped like a clothespin (fig. 10, 1-7), but larger. This loosens the bark in strands so that it can easily be removed by the hands.

**Marketing willows.**—Peeled rods may be sold to local basket makers or to large willow-ware makers, who are usually glad to buy home-grown instead of imported stock. For the larger market the rods must be white and properly sorted according to sizes in order to compete with the imported stock, which is of good color and consists of long, straight, branchless rods, carefully sorted into equal lengths and into grades of uniform quality. Those who sell to local basket makers are able to offer them at a lower price than those who have to ship to a distant market. The grower who sells to local consumers can also keep in constant touch with his customers and cater more successfully to their requirements in special varieties and grades of rods than can the grower whose product goes to larger markets.

Upon application, the Forest Service, Washington, D. C., will furnish to willow growers the names and addresses of the manufacturers of willow ware nearest to them.